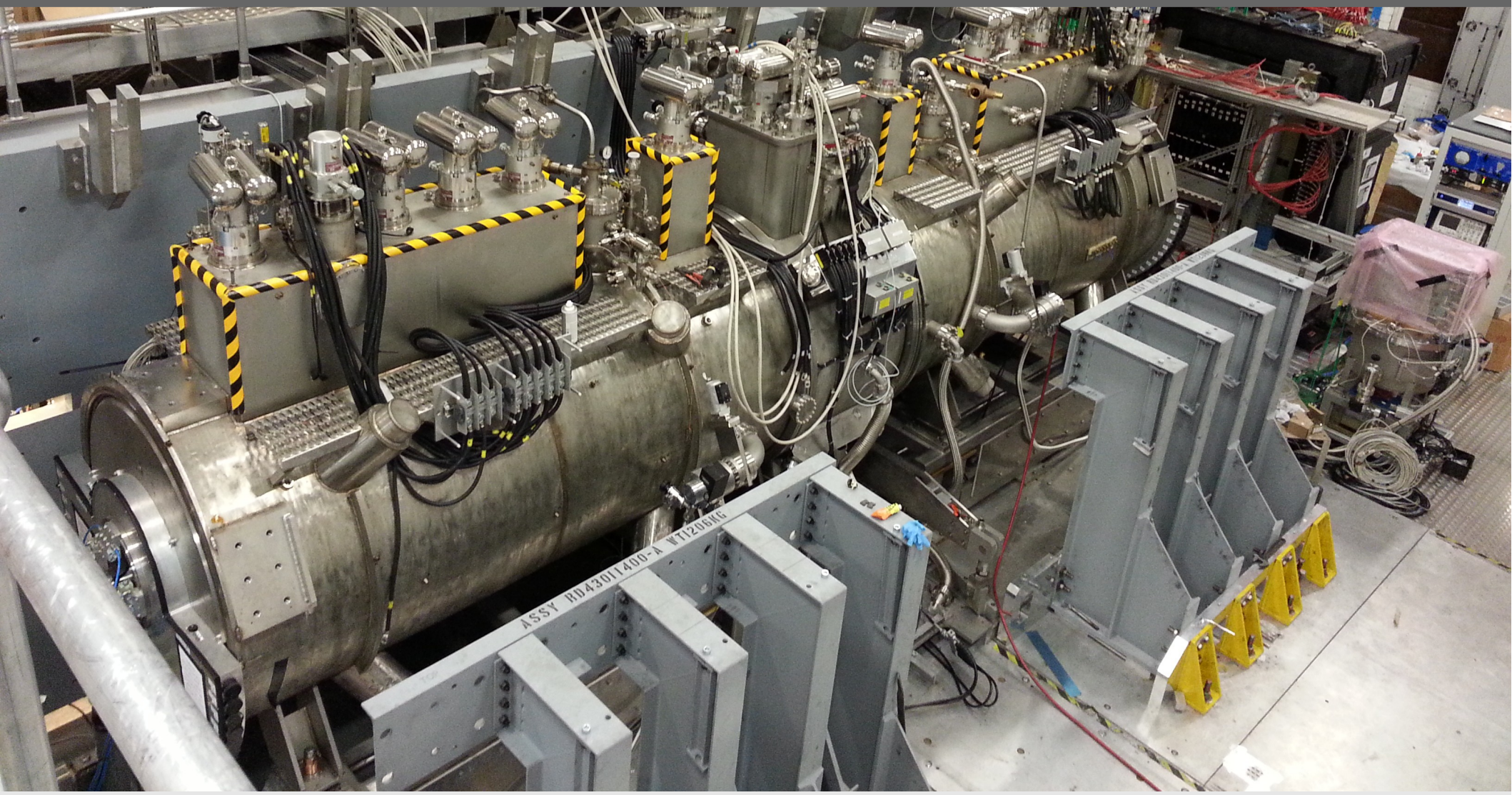# MICE Spectrometers

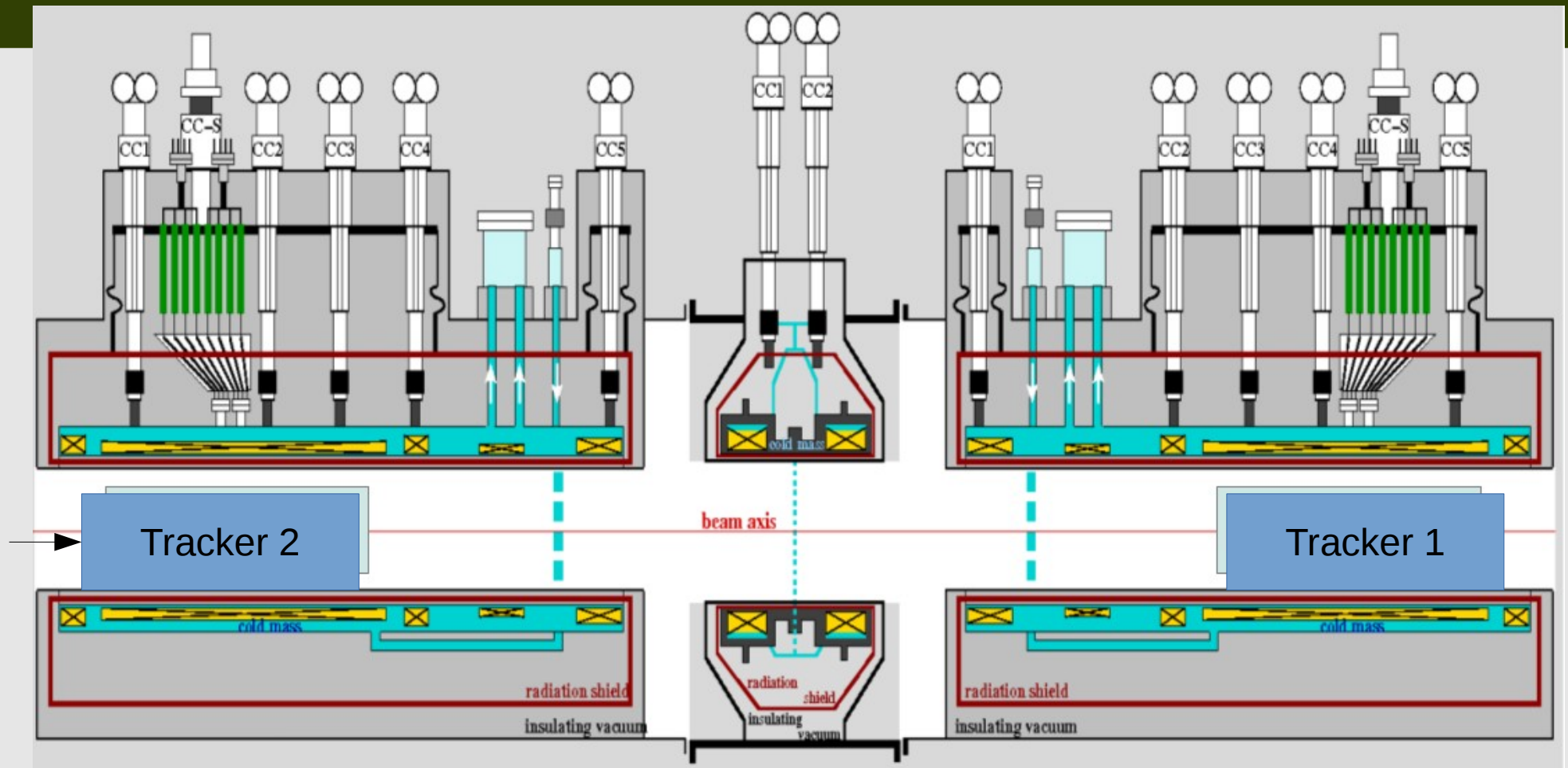*On behalf of....*

Contents

- Spectrometer Overview
    - Installation
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- Tracker Commissioning
    - Cryostats and cooling
    - Internal LED
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    - Mock Data Run 3
    - Beam Plans

E. Overton

Spectrometer Overview

- Tracking detectors are placed within the 4T uniform field region of the Spectrometer Solenoids.
- MICE will use single particle measurements to achieve a high precision emittance measurement.

Spectrometer Installation

- The tracker detectors were installed in each spectrometer in building R9.

- Once complete the spectrometers were transported into the MICE Experimental Hall.

- The diffuser was fitted to the upstream tracker within the MICE hall.

- The image shows the upstream trackers bulkhead connectors and the installed diffuser in the centre.

E. Overton

Spectrometer Preperation

To prepare for cool down a number of visits from the LBNL technicians has been made. In the last visit (27/4/15 to 8/5/15) a great deal was accomplished:

- Power feedthroughs were replaced.
- Gate Valved installed
- Cold head cleaning and installation.
- Leak Checks
- Compressor power and cooling hookups.

Still more work is needed, and technicians will be returning to RAL on Monday.
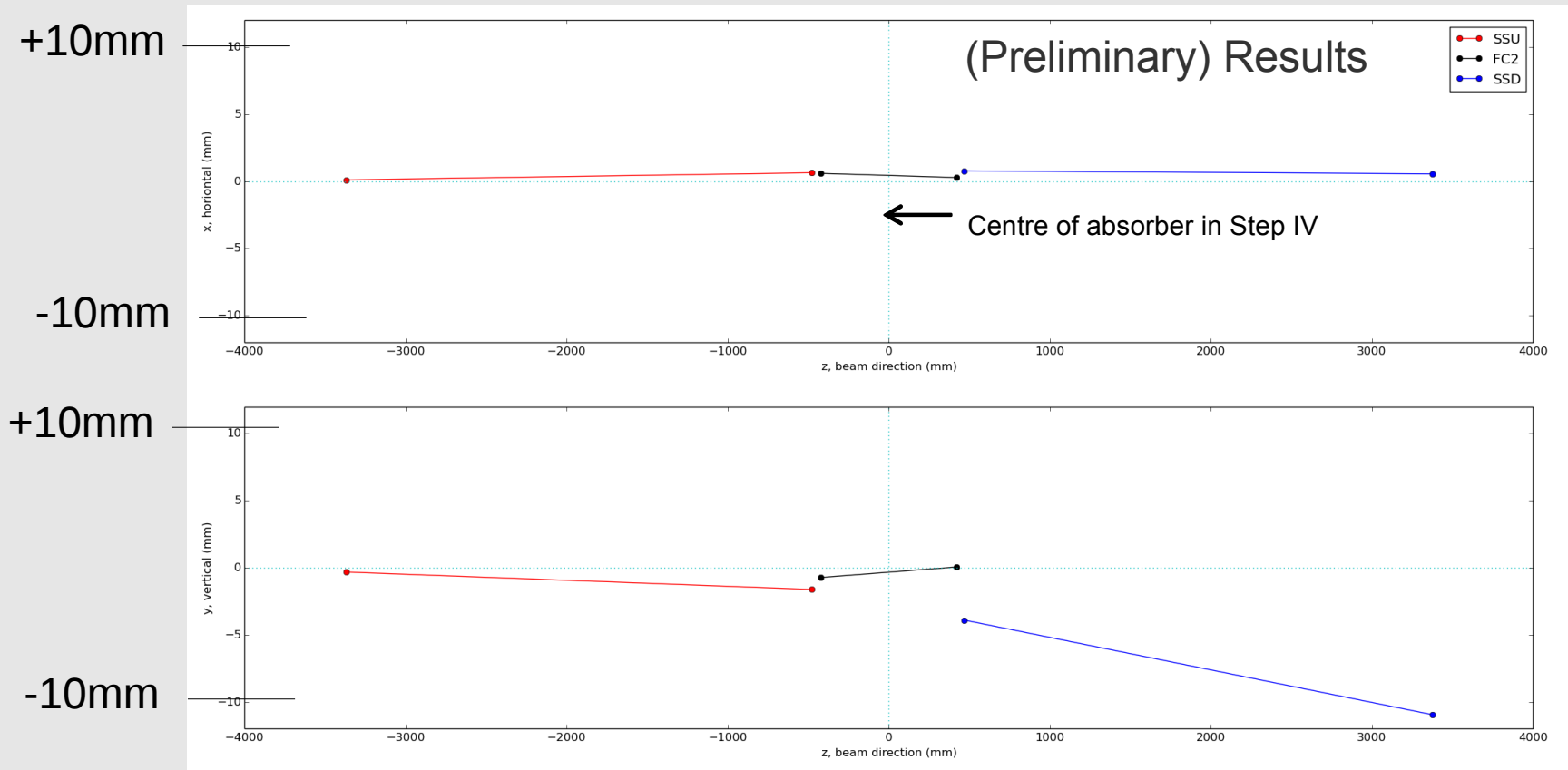
For more details see Steve Virostek's talk:
https://indico.cern.ch/event/389558/contribution/7/material/slides/1.pdf

Spectrometer Alignment

- Studies of the magnetic field alignment of the spectrometers and focus coil have been completed by V. Blackmore and J. Cobb.
- See the full slides here:
  https://indico.cern.ch/event/389558/contribution/6/material/slides/0.pdf

Tracker Cryostats & Cooling

The Fibre trackers trackers are connected to 8 VLPC cassettes, located in 4 cryostats (2 per tracker), which are in turn readout using using D0 AFE-IIt boards.

The cryostat's were migrated to the MICE Hall in November 2014, when cool down and testing began:

- Cryostat's failed to achieve nominal operating temperature. VLPCs temperatures between 9.5-10.5K:
    - Compressor hoses have been shortened (~1k difference between short and long hoses).
    - Cold heads cleaned.
    - => Cryostat's cooled to specification (~6.1K without heaters)

- Oxford Temperature controllers for cryostats were unreliable:
    - New Oxford temperature controllers purchased and installed. Now working.

- Cryostats cold & temperature regulation working.
    - Except on cryo2: but large cold end → VLPC temperature differential limits temperature regulation. VLPC's at around 9.1K. Proceeding for now. Investigating 60Hz mains to deliver
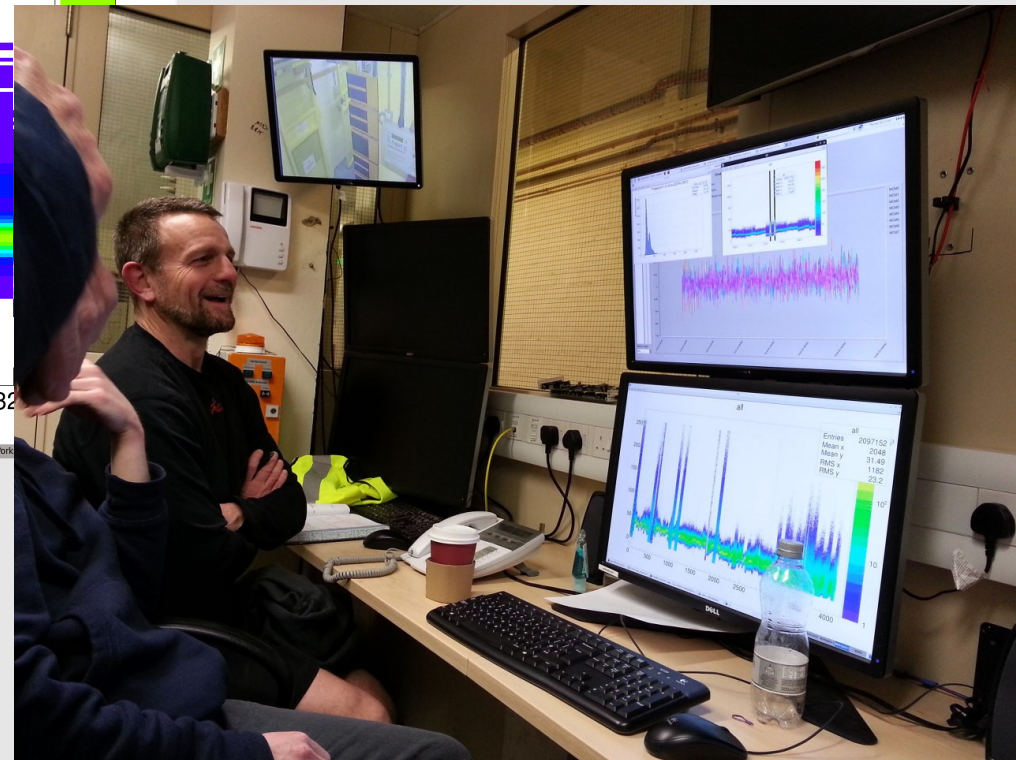
Tracker Internal LED
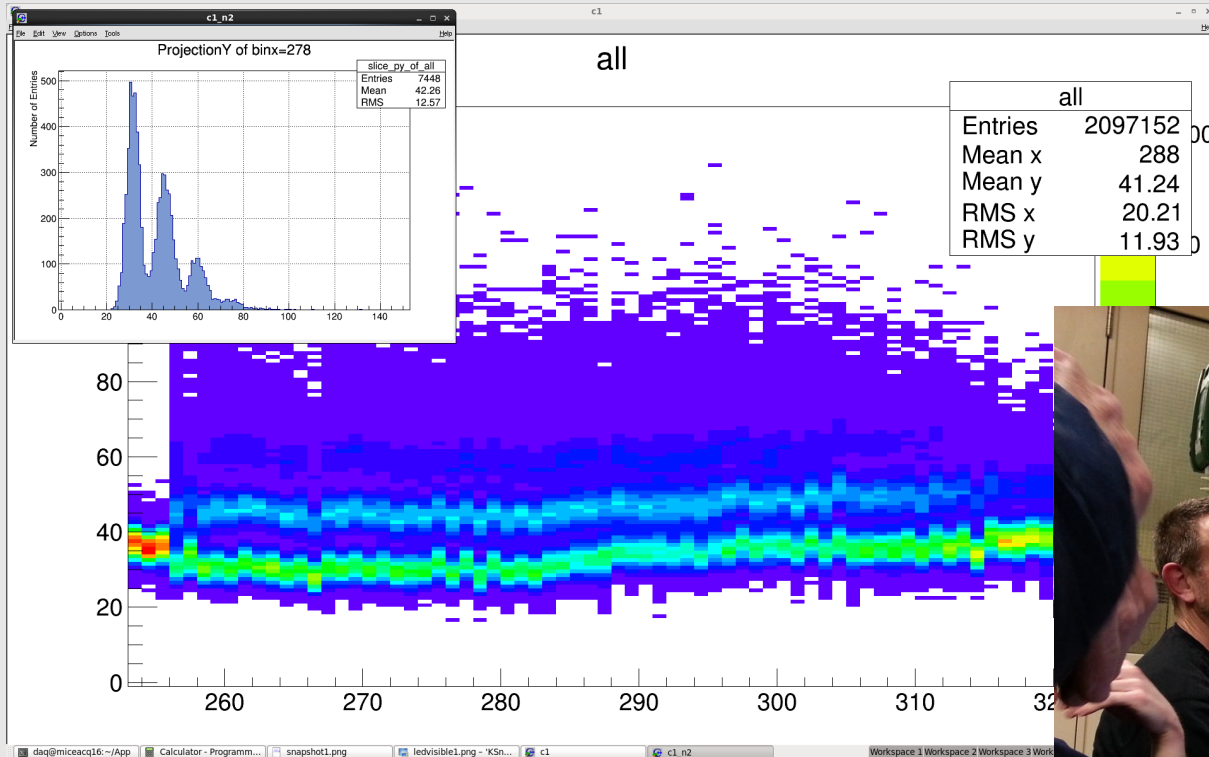
Internal LED

During January there was sufficiently cool and calibrated VLPCs to conduct a test of the internal LED system. Light was observed!
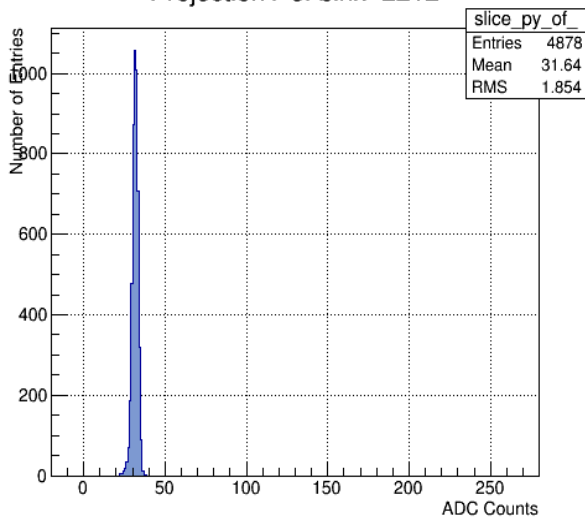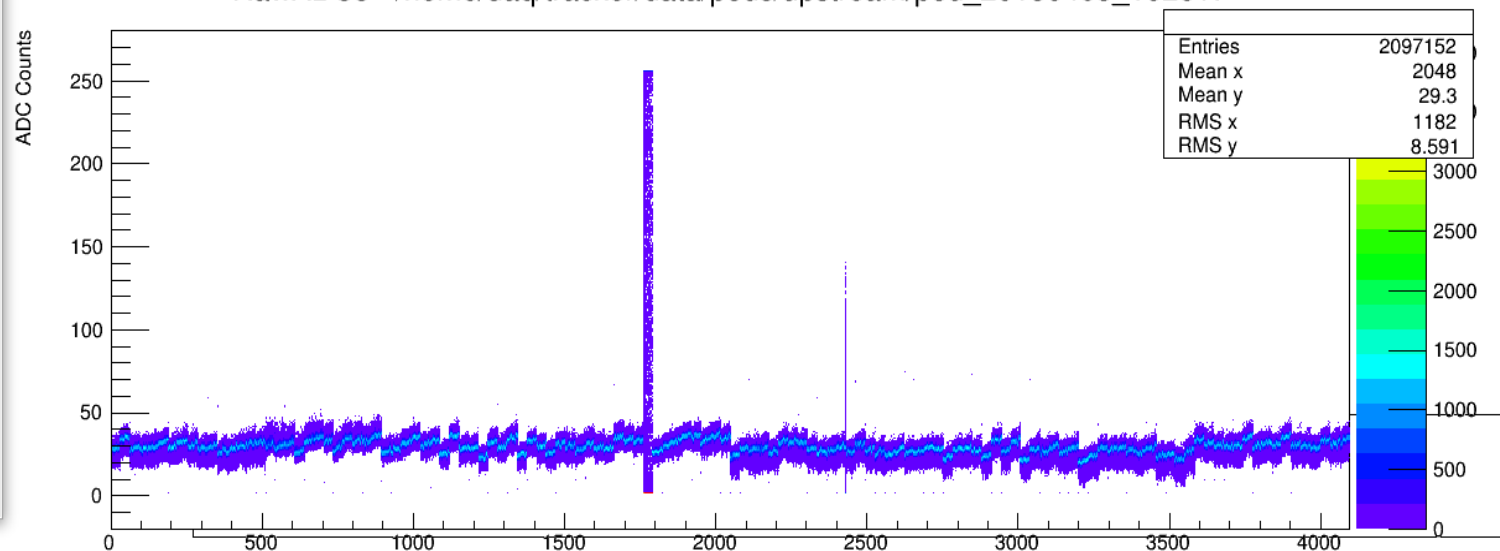
Tracker Noise Issues

- In January we spotted substantial noise on the Front End Electronics.
    - We are sensitive to 10 → 100 <u>micro</u> V differential noise on the front ends...
    - A great effort has been spent to minimise this.

- We have discovered some general improvements which on the whole improve things:
    - Improved backplane wiring
    - Improved grounding

- Finally after reducing the externally generated integration gate was the noise reduced to a normal amount. Suspect there was insufficient time for the Trip-t to complete the tasks at the end of each integration period.
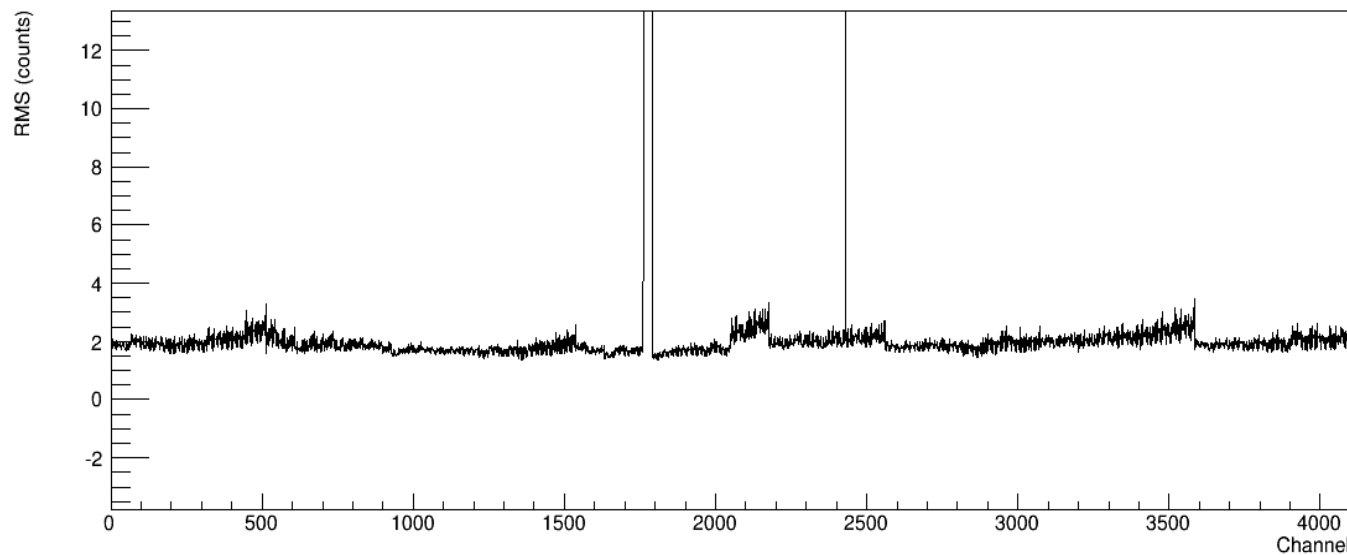
Tracker Noise Issues

Tracker Controls

- Following the issues in December with the controls software the controls VME interface was extended to also support CAEN VME cards, which are common to all MICE DAQ equipment.

- In addition the controls software was prone to throwing exceptions and crashing in the event of missing hardware/unexpected responses
  - Exception safety in code was checked /improved
  - Most common exceptions now caught and handled

- Code was slow to configure boards (~20mins for tracker).
  - Orignal code base has been (non-destructively) extended.
  - Now configuration happens in parallel (4x speedup).

- Additional expert control added:
  - Access to 1553/FPGA registers now available via a text interface on a TCP socket. This allows detailed board debugging/firmware checks/reprogramming.

Tracker Controls

- Old user GUI was difficult to interpret and the EPICS interface was not providing sufficient feedback for archiving etc...

- Pierrick Wrapped extended controls code with new IOC and a simpler GUI:
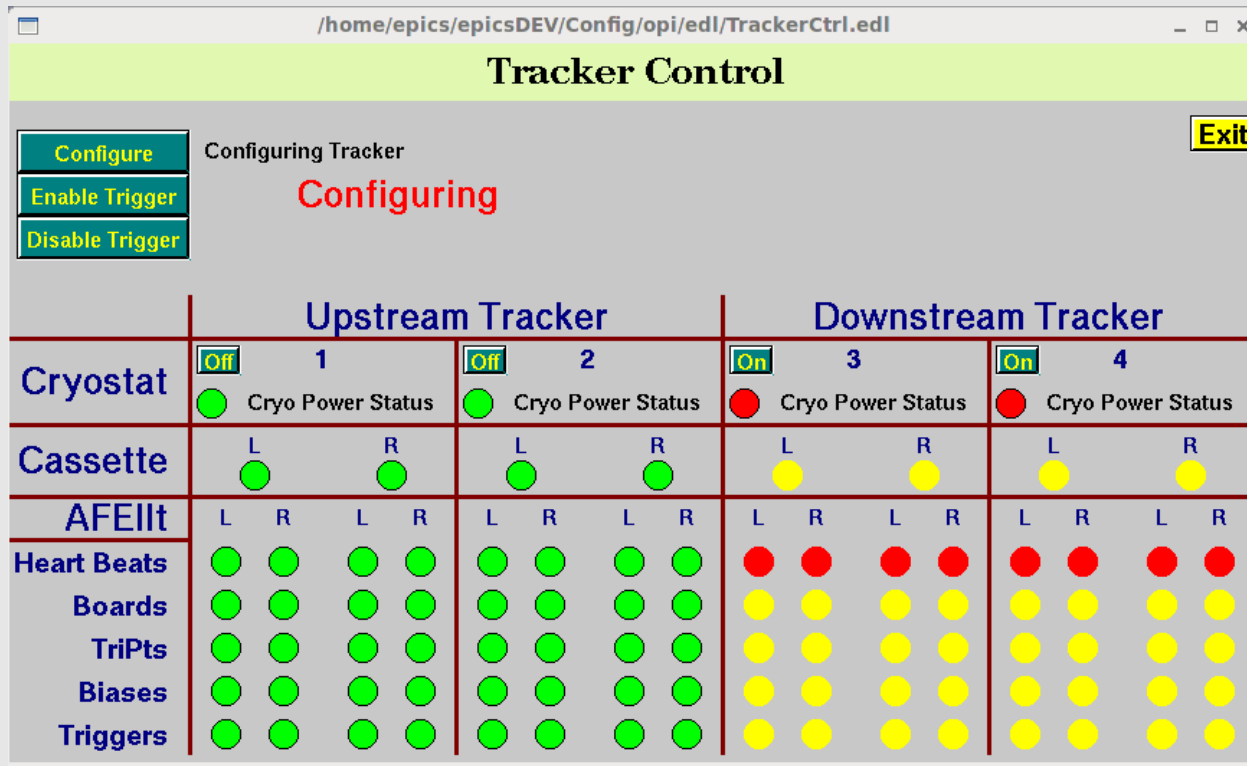
Tracker Trigger

- MICE trigger has been replaced since the single tracker station test in 2012.

- New trigger is handled within a FPGA chip, which is diffucult to insert specifc veto signals into.

- Trigger code was expanded to include additional veto for tracker operation. This was tested in the first MICE Mock Data Run.

- Yordan is now validating the extensions to the trigger in a VHDL simulation. Will be done for next week.
    - Following this we will flash the trigger with the new firmware and validate visually with a scope prior to beam.

Tracker DAQ

- Data acquisition code in present state is operable, however it is unnecessarily complex (10+ objects, 4 interface objects)!

- Does not output status and error data using the common DAQ machinery, which will make bug finding hard.

- Plan is to rewrite existing code with only two objects, using common DAQ machinery.

- This will make checking and error finding much easier.

- Not needed for initial data taking, but will be completed in the near future.

Tracker Calibration

- Now noise issues are resolved and temperature regulation is operational, it is possible to begin calibrating the front end boards.

- We need to obtain:
  - Optimum Biases
  - Pedestal and Gain for each VLPC channel.
  -

- Automated data collection script sets VLPC biases, LED states and runs David's MiniDAQ.

- Currently operating the calibration code:
  - Finding the singles peak has been tricky to get right for all VLPCs
  - After tweaking the ROOT TSpectrum object and alternative technique has been developed which only requires the pedestal peak to be fitted.

- Now performing calibrations on Cryos 1 & 2. Should be complete by 22/5/15.

Tracker MDR

- The Unpacking for the tracker was checked by online monitoring in the first Mock Data Run. This showed the expected result for noise only.

- The MICE Analysis (MAUS) code currently has issues in the processing the data from the unpack, this is an ongoing issue.

- Next week is Mock Data Challenge 3 where we will be extensively focusing on the tracker readout :
  - First task will be to readout the tracker using the MICE Trigger and the MICE DAQ. Both these have been demonstrated before
  - Next we will check the data using the Online Monitoring System, which has been demonstrated before.
  - Finally we will work towards fixing the MAUS issue.
  - For these tasks relevant Tracker, DAQ and Online Monitoring experts will be available at RAL.

Tracker Light/Wave-guides

- Once calibration is complete attachment of tracker wave guides will commence.
- Focus is on upstream tracker, then downstream.
- Installation of wave guides will be tricky:
  - Small slot in partial return yoke to feed through.
  - Will require cutting and re attaching heat shrink to give additional movement for routing.
- Geoff and Kevin, who have the most experience working with the wave guides will complete the work. In addition Chris Heit will be taking notes for the channel mapping.
- Will test mapping with beam.
- After ISIS run completes then the internal LED system will be used to study the transmission of each fibre.

Tracker Beam Plans

- ISIS user run begins on 2nd June. Plan is to hit the ground running.

- Trigger will be cabled up and checked in advance.

- First shift will be used to set up and check the modifications to the MICE trigger.

- Due to the firmware change on the trigger a Time Of Flight calibration will need to be completed prior to timing in the front end electronics.

- Once the TOF is calibrated then the upstream trackers' front end electronics will be timed into the beam, using a similar technique as was tested in the single station test.

- When commissioned will move to "straight" tracks to study alignment.

E. Overton

Conclusion

- The MICE Hall is a busy place.
- Lots of effort going into preparation for running.

- From a tracker perspective we will be collecting data in the next ISIS user run.